Apprenticeship and Industry Training

Transport Refrigeration Technician

Apprenticeship Course Outline

4116 (2016)

Alberta

Apprenticeship and Industry Training

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Transport Refrigeration Technician
Table of Contents

Transport Refrigeration Technician Table of Contents 1
Apprenticeship 2
Apprenticeship and Industry Training System 2
Apprenticeship Safety 4
Procedures for Recommending Revisions to the Course Outline 5
Apprenticeship Route toward Certification 6
Transport Refrigeration Technician Training Profile 7

Course Outline

First Period Technical Training 11
Second Period Technical Training 21
Third Period Technical Training 28

Apprenticeship

Apprenticeship is post-secondary education with a difference. Apprenticeship begins with finding an employer. Employers hire apprentices, pay their wages and provide on-the-job training and work experience. Approximately 80 per cent of an apprentice's time is spent on the job under the supervision of a certified journeyperson or qualified tradesperson. The other 20 per cent involves technical training provided at, or through, a post-secondary institution – usually a college or technical institute.

To become certified journeypersons, apprentices must learn theory and skills, and they must pass examinations. Requirements for certification—including the content and delivery of technical training—are developed and updated by the Alberta Apprenticeship and Industry Training Board on the recommendation of Transport Refrigeration Technician Provincial Apprenticeship Committee.

The graduate of the Transport Refrigeration Technician apprenticeship program is a certified journeyperson who will be able:

- to diagnose repair, maintain and operate transport refrigeration equipment used to heat or cool the load as well as of diesel engines, APUs and other prime movers
- to use tools and equipment in order to carry out repairs according to manufacturer's
- to read and understand work orders, prepare estimates, interpret technical references and diagrams
- to download data from monitoring systems to diagnose problems and set parameters for proper operation
- to write work orders and update maintenance logs
- to be familiar with the work in related trades such as machinist, heavy equipment technician and welder
- to be familiar with and apply all regulations and legislation associated with the industry
- to perform assigned tasks in accordance with quality and production standards required by industry

Apprenticeship and Industry Training System

Industry-Driven

Alberta's apprenticeship and industry training system is an industry-driven system that ensures a highly skilled, internationally competitive workforce in more than 50 designated trades and occupations. This workforce supports the economic progress of Alberta and its competitive role in the global market. Industry (employers and employees) establishes training and certification standards and provides direction to the system through an industry committee network and the Alberta Apprenticeship and Industry Training Board. The Alberta government provides the legislative framework and administrative support for the apprenticeship and industry training system.

Alberta Apprenticeship and Industry Training Board

The Alberta Apprenticeship and Industry Training Board provides a leadership role in developing Alberta's highly skilled and trained workforce. The board's primary responsibility is to establish the standards and requirements for training and certification in programs under the Apprenticeship and Industry Training Act. The board also provides advice to the Minister of Advanced Education on the needs of Alberta's labour market for skilled and trained workers, and the designation of trades and occupations.

The thirteen-member board consists of a chair, eight members representing trades and four members representing other industries. There are equal numbers of employer and employee representatives.

Industry Committee Network

Alberta's apprenticeship and industry training system relies on a network of industry committees, including local and provincial apprenticeship committees in the designated trades, and occupational committees in the designated occupations. The network also includes other committees such as provisional committees that are established before the designation of a new trade or occupation comes into effect. All trade committees are composed of equal numbers of employer and employee representatives. The industry committee network is the foundation of Alberta's apprenticeship and industry training system.

Local Apprenticeship Committees (LAC)

Wherever there is activity in a trade, the board can set up a local apprenticeship committee. The board appoints equal numbers of employee and employer representatives for terms of up to three years. The committee appoints a member as presiding officer. Local apprenticeship committees:

- monitor apprenticeship programs and the progress of apprentices in their trade, at the local level
- make recommendations to their trade's provincial apprenticeship committee (PAC) about apprenticeship and certification in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- make recommendations to the board about the appointment of members to their trade's PAC
- help settle certain kinds of disagreements between apprentices and their employers
- carry out functions assigned by their trade's PAC or the board

Provincial Apprenticeship Committees (PAC)

The board establishes a provincial apprenticeship committee for each trade. It appoints an equal number of employer and employee representatives, and, on the PAC's recommendation, a presiding officer - each for a maximum of two terms of up to three years. Most PACs have nine members but can have as many as twenty-one. Provincial apprenticeship committees:

- Make recommendations to the board about:
    - standards and requirements for training and certification in their trade
    - courses and examinations in their trade
    - apprenticeship and certification
    - designation of trades and occupations
    - regulations and orders under the Apprenticeship and Industry Training Act
- monitor the activities of local apprenticeship committees in their trade
- determine whether training of various kinds is equivalent to training provided in an apprenticeship program in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- consult with other committees under the Apprenticeship and Industry Training Act about apprenticeship programs, training and certification and facilitate cooperation between different trades and occupations
- consult with organizations, associations and people who have an interest in their trade and with employers and employees in their trade
- may participate in resolving certain disagreements between employers and employees
- carry out functions assigned by the board

Transport Refrigeration Technician PAC Members at the Time of Publication

Mr. R. Fleming	Calgary.....	Presiding Officer
Mr. J. Schmode	Calgary.....	Employer
Mr. D. Mueller	High River	Employer
Mr. L. Brugess	Ft. McMurray.	Employer
Mr. J. Winfield	Calgary.....	Employer
Mr. M. Purcell	Ft. McMurray.	Employee

Alberta Government

Alberta Advanced Education works with industry, employer and employee organizations and technical training providers to:

- facilitate industry's development and maintenance of training and certification standards
- provide registration and counselling services to apprentices and employers
- coordinate technical training in collaboration with training providers
- certify apprentices and others who meet industry standards

Apprenticeship Safety

Safe working procedures and conditions, incident/injury prevention, and the preservation of health are of primary importance in apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of government, employers, employees, apprentices and the public. Therefore, it is imperative that all parties are aware of circumstances that may lead to injury or harm.

Safe learning experiences and healthy environments can be created by controlling the variables and behaviours that may contribute to or cause an incident or injury. By practicing a safe and healthy attitude, everyone can enjoy the benefit of an incident and injury free environment.

Alberta Apprenticeship and Industry Training Board Safety Policy

The Alberta Apprenticeship and Industry Training Board (board) fully supports safe learning and working environments and emphasizes the importance of safety awareness and education throughout apprenticeship training- in both on-the- job training and technical training. The board also recognizes that safety awareness and education begins on the first day of on-the-job training and thereby is the initial and ongoing responsibility of the employer and the apprentice as required under workplace health and safety training. However the board encourages that safe workplace behaviour is modeled not only during on-the-job training but also during all aspects of technical training, in particular, shop or lab instruction. Therefore the board recognizes that safety awareness and training in apprenticeship technical training reinforces, but does not replace, employer safety training that is required under workplace health and safety legislation.

The board has established a policy with respect to safety awareness and training:

> **The board promotes and supports safe workplaces, which embody a culture of safety for all apprentices, employers and employees. Employer required safety training is the responsibility of the employer and the apprentice, as required under legislation other than the *Apprenticeship and Industry Training Act.***

The board's complete document on its 'Apprenticeship Safety Training Policy' is available at www.tradesecrets.alberta.ca; access the website and conduct a search for 'safety training policy'.

Implementation of the policy includes three common safety learning outcomes and objectives for all trade course outlines. These common learning outcomes ensure that each course outline utilizes common language consistent with workplace health and safety terminology. Under the title of 'Standard Workplace Safety', this first section of each trade course outline enables the delivery of generic safety training; technical training providers will provide trade specific examples related to the content delivery of course outline safety training.

Occupational Health and Safety

A tradesperson is often exposed to more hazards than any other person in the work force and therefore should be familiar with and apply the Occupational Health and Safety Act, Regulations and Code when dealing with personal safety and the special safety rules that apply to all daily tasks.

Occupational Health and Safety (a division of Alberta Human Services) conducts periodic inspections of workplaces to ensure that safety regulations for industry are being observed.

Additional information is available at www.humanservices.alberta.ca

Technical Training

Apprenticeship technical training is delivered by the technical institutes and colleges in the public post-secondary system throughout Alberta. The colleges and institutes are committed to delivering the technical training component of Alberta apprenticeship programs in a safe, efficient and effective manner. All training providers place a strong emphasis on safety that complements safe workplace practices towards the development of a culture of safety for all trades.

The technical institutes and colleges work with Alberta's Apprenticeship and Industry Training Board, industry committees and Alberta Advanced Education to enhance access and responsiveness to industry needs through the delivery of the technical training component of apprenticeship programs across the Province. They develop curriculum from the course outlines established by industry and provide technical training to apprentices.

The following institutions deliver Transport Refrigeration Technician apprenticeship technical training:

Southern Alberta Institute of Technology (Main Campus)
Northern Alberta Institute of Technology (Main Campus)
(periods one and three)

Procedures for Recommending Revisions to the Course Outline

Advanced Education has prepared this course outline in partnership with the Transport Refrigeration Technician Provincial Apprenticeship Committee and the Refrigeration and Air Conditioning Mechanic Provincial Apprenticeship Committee.

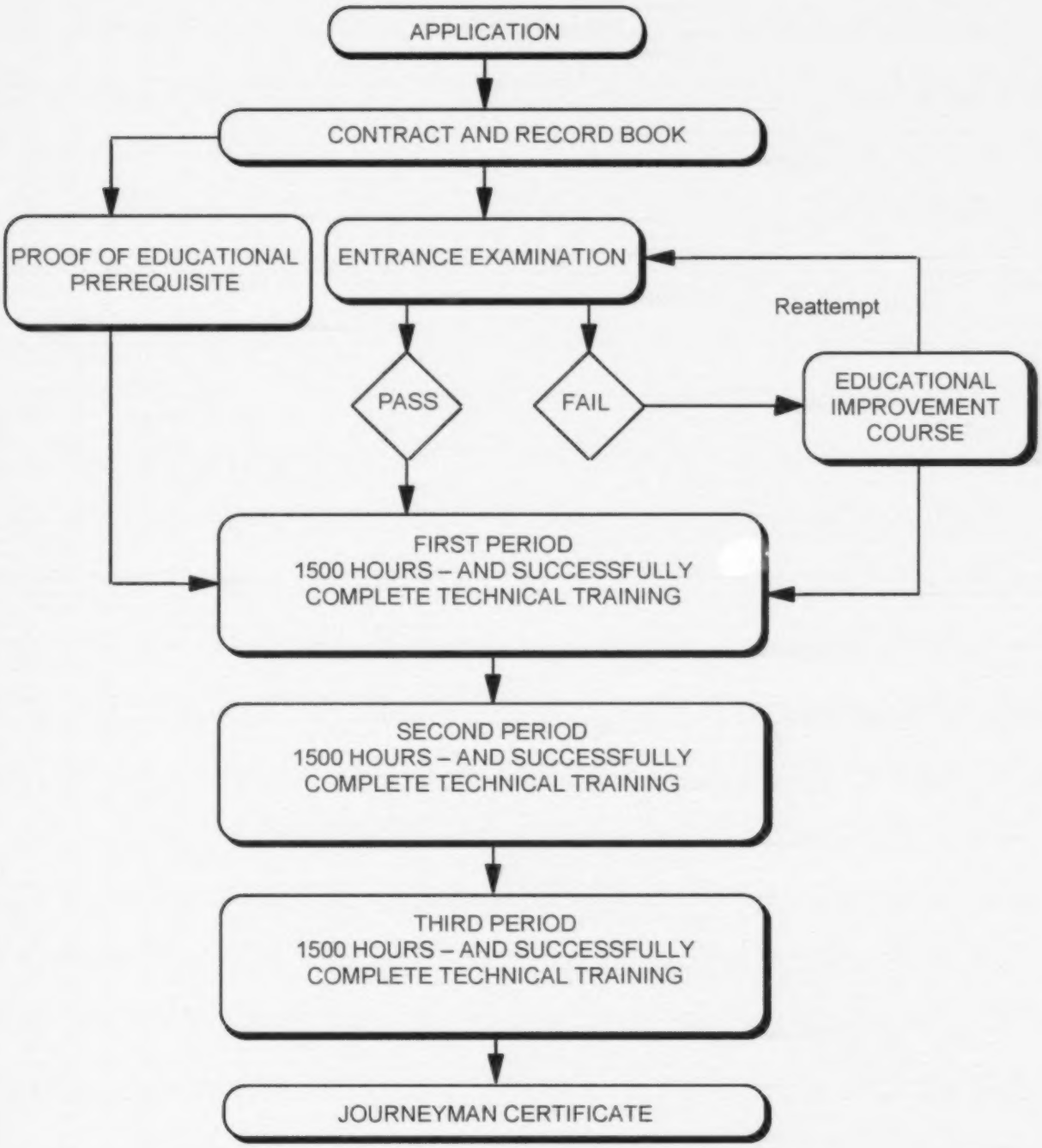
This course outline was approved on September 25, 2015 by the Alberta Apprenticeship and Industry Training Board on a recommendation from the Provincial Apprenticeship Committee. The valuable input provided by representatives of industry and the institutions that provide the technical training is acknowledged.

Any concerned individual or group in the province of Alberta may make recommendations for change by writing to:

Transport Refrigeration Technician Provincial Apprenticeship Committee
c/o Industry Programs and Standards
Apprenticeship and Industry Training
Advanced Education
10th floor, Commerce Place
10155 102 Street NW
Edmonton AB T5J 4L5

It is requested that recommendations for change refer to specific areas and state references used. Recommendations for change will be placed on the agenda for regular meetings of the Transport Refrigeration Technician Provincial Apprenticeship Committee.

Apprenticeship Route toward Certification



Transport Refrigeration Technician Training Profile

FIRST PERIOD

(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

OCCUPATIONAL SKILLS
60 HOURS

A	B	C
Safety Legislation, Regulations & Industry Policy in the Trades – 2 Hours	Climbing, Lifting, Rigging and Hoisting – 1 Hour	Hazardous Materials & Fire Protection – 3 Hours
D	**E**	**F**
Apprenticeship Training Program – 2 Hours	Tools and Instruments – 8 Hours	Ladders, Scaffolds and Lifts – 2 Hours
G	**H**	**I**
Rigging and Hoisting Equipment – 6 Hours	Relevant Codes – 2 Hours	Customer Relations – 6 Hours
J	**K**	**L**
Introduction to Drawing Interpretation – 4 Hours	Pipe Working Skills Soldering and Brazing – 20 Hours	Materials and Fastening Devices – 4 Hours

SECTION TWO

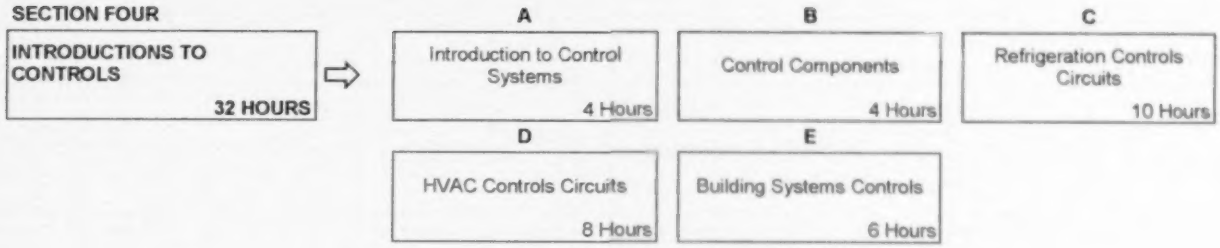
INTRODUCTION TO REFRIGERATION, AIR CONDITIONING AND HEATING
104 HOURS

A	B	C
Refrigeration Principles – 14 Hours	Vapour Compression Cycle – 10 Hours	Introduction to Refrigeration Enthalpy and Gas Laws – 20 Hours
D	**E**	**F**
Air Properties and Air Flow Designs – 10 Hours	Air Handling Systems and Accessories – 10 Hours	Air Filtration – 4 Hours
G	**H**	**I**
Refrigeration and Air Conditioning Relevant Codes – 4 Hours	Introduction to Valve Design and Functions – 4 Hours	Refrigerant and Oil Handling – 14 Hours
J	**K**	**L**
Introduction Gasfitting Fundamentals – 5 Hours	Properties of Gas and Principles of Combustion – 4 Hours	Introduction Gasfitting Code and Regulations – 5 Hours

SECTION THREE

INTRODUCTION TO ELECTRICAL THEORY
44 HOURS

A	B	C
Introduction to Electrical Safety, Connections and Meters – 8 Hours	Current, Voltage, and Resistance – 6 Hours	Series Resistive Circuits – 4 Hours
D	**E**	**F**
Parallel Resistive Circuits – 4 Hours	Series-Parallel Resistive Circuits – 6 Hours	Methods of Producing EMF and Magnetism – 8 Hours
G	**H**	
Fundamentals of Alternating Current – 6 Hours	Arc Flash and Electrical Safety – 2 Hours	


SECTION FOUR
INTRODUCTIONS TO CONTROLS
32 HOURS
A
Introduction to Control Systems
4 Hours
B
Control Components
4 Hours
C
Refrigeration Controls Circuits
10 Hours
D
HVAC Controls Circuits
8 Hours
E
Building Systems Controls
6 Hours

SECOND PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

ENGINE BASICS
47 HOURS

A	B	C
Engine Basics 9 Hours	Blocks and Liners 4 Hours	Pistons and Connecting Rods 4 Hours
D	**E**	**F**
Crankshafts 3 Hours	Camshafts 4 Hours	Valve Trains 5 Hours
G		
Cylinder Heads 18 Hours		

SECTION TWO

ENGINE SUPPORT SYSTEMS
25 HOURS

A	B	C
Induction Systems 6 Hours	Exhaust Systems 6 Hours	Emission Control Systems 7 Hours
D		
Lubrication and Cooling Systems 6 Hours		

SECTION THREE

FUEL SYSTEMS
39 HOURS

A	B	C
Fuel Injection Components 30 Hours	Engine Testing and Adjustments 6 Hours	Electronic Fuel Systems 3 Hours

SECTION FOUR

DC FUNDAMENTALS
48 HOURS

A	B	C
Starting Systems 9 Hours	Mechanical Generator Systems 9 Hours	Battery Fundamentals 3 Hours
D	**E**	**F**
DC Electrical Circuits 12 Hours	Wiring Diagrams 12 Hours	Microprocessors 3 Hours

SECTION FIVE

REFRIGERANT CONCEPTS
49 HOURS

A	B	C
Compressors 6 Hours	Refrigeration Components 10 Hours	System Specific Diagnostics 15 Hours
D	**E**	
Soldering and Brazing 12 Hours	Factors Affecting System Performance 6 Hours	

SECTION SIX

SECONDARY SYSTEMS
28 HOURS

A	B	C
Liquid Propane Gas (LPG) Heating Systems 6 Hours	Liquid Fuel Fired Heating Systems 18 Hours	Auxiliary Power Systems 4 Hours

SECTION SEVEN

COACHING, ALBERTA'S INDUSTRY NETWORK
4 HOURS

A	B
Workplace Coaching Skills 2 Hours	Alberta's Industry Network 2 Hours

THIRD PERIOD
(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

BASIC REFRIGERATION AND AIR CONDITIONING
128 HOURS

A	B	C
Evaporator Feed Controls and Refrigeration Effect 16 Hours	Automatic Flow Controls and Applications 10 Hours	Refrigeration Accessories 4 Hours
D	**E**	**F**
Compressors 14 Hours	Evaporators and Condensers 6 Hours	Evaporating Condensers and Cooling Towers 6 Hours
G	**H**	**I**
System Install and Commissioning 36 Hours	System Calculations and Analysis 24 Hours	Retrofitting and Conversions 8 Hours
J		
Split Systems 4 Hours		

SECTION TWO

BASIC HEATING
32 HOURS

A	B	C
Natural Draft Burner Adjustments and Gas Consumption 6 Hours	Pilots, Pilot Burners, Thermocouples and Thermopiles 6 Hours	Pressure Regulators and Orifices 8 Hours
D	**E**	**F**
Introduction to Flues, Draft Hoods and Vent Connections 6 Hours	Single Line Drawings 4 Hours	Heating with Alternative Methods 2 Hours

SECTION THREE

BASIC CONTROLS
32 HOURS

A	B	C
Principles of Automatic Heating and Cooling Controls 6 Hours	Temperature Sensing and Control Devices 4 Hours	Basic Gas-Fired Forced-Air Heating Systems 6 Hours
D	**E**	**F**
Mid/High-Efficiency/Gas-Fired/Forced-Air Heating Systems 6 Hours	Basic Hot Water Heating Systems 2 Hours	HVAC Units 8 Hours

SECTION FOUR

BASIC ELECTRICAL THEORY
48 HOURS

A	B	C
Single Phase Transformers 4 Hours	Single Phase Motors 14 Hours	Compressor and Electrical Circuit Components 10 Hours
D	**E**	**F**
Three Phase Fundamentals 6 Hours	Troubleshooting Electrical Problems 10 Hours	Introduction to Canadian Electrical Code 2 Hours
G		
Class 1 and Class 2 Circuits 2 Hours		

NOTE: The hours stated are for guidance and should be adhered to as closely as possible. However, adjustments must be made for rate of apprentice learning, statutory holidays, registration and examinations for the training establishment and Apprenticeship and Industry Training.

FIRST PERIOD TECHNICAL TRAINING
TRANSPORT REFRIGERATION TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE: ..... OCCUPATIONAL SKILLS ..... 60 HOURS

A. Safety Legislation, Regulations & Industry Policy in the Trades ..... 2 Hours

Outcome: ***Describe legislation, regulations and practices intended to ensure a safe work place in this trade.***

1. Demonstrate the ability to apply the Occupational Health and Safety Act, Regulation and Code.
2. Explain the role of the employer and employee in regard to Occupational Health and Safety (OH&S) regulations, Worksite Hazardous Materials Information Systems (WHMIS), fire regulations, Workers Compensation Board regulations, and related advisory bodies and agencies.
3. Explain industry practices for hazard assessment and control procedures.
4. Describe the responsibilities of workers and employers to apply emergency procedures.
5. Describe positive tradesperson attitudes with respect to housekeeping, personal protective equipment and emergency procedures.
6. Describe the roles and responsibilities of employers and employees with respect to the selection and use of personal protective equipment (PPE).
7. Select, use and maintain appropriate PPE for worksite applications.

B. Climbing, Lifting, Rigging and Hoisting ..... 1 Hours

Outcome: ***Describe the use of personal protective equipment (PPE) and safe practices for climbing, lifting, rigging and hoisting in this trade.***

1. Select, use and maintain specialized PPE for climbing, lifting and load moving equipment.
2. Describe manual lifting procedures using correct body mechanics.
3. Describe rigging hardware and the safety factor associated with each item.
4. Select the correct equipment for rigging typical loads.
5. Describe hoisting and load moving procedures.

C. Hazardous Materials & Fire Protection ..... 3 Hours

Outcome: ***Describe the safety practices for hazardous materials and fire protection in this trade.***

1. Describe the roles, responsibilities features and practices related to the workplace hazardous materials information system (WHMIS) program.
2. Describe the three key elements of WHMIS.
3. Describe handling, storing and transporting procedures when dealing with hazardous material.
4. Describe safe venting procedures when working with hazardous materials.
5. Describe fire hazards, classes, procedures and equipment related to fire protection.

D. Apprenticeship Training Program ..... 2 Hours

Outcome: ***Manage an apprenticeship to earn journeyman certification.***

1. Describe the contractual responsibilities of the apprentice, employer and Alberta Apprenticeship and Industry Training.
2. Describe the purpose of the apprentice record book.
3. Describe the procedure for changing employers during an active apprenticeship.
4. Describe the purpose of the course outline.
5. Describe the procedure for advancing through apprenticeship.
6. Describe advancement opportunities in this trade.

E. Tools and Instruments ..... 8 Hours

Outcome: ***Use hand tools and power tools.***

1. Describe types, uses and care of hand, power tools and equipment.
2. Demonstrate the use of hand tools and power tools used in the industry.
3. Demonstrate proper connections of refrigeration gauges and operation of service valves.
4. Perform calculations related to measurement using imperial and metric units.

F. Ladders, Scaffolds and Lifts ..... 2 Hours

Outcome: ***Use ladders, scaffolds and lifts.***

1. Describe the use of various types of ladders.
2. Describe the use of various types of scaffolds.
3. Describe the use of various types of lifts.

G. Rigging and Hoisting Equipment ..... 6 Hours

Outcome: ***Use rope and rigging components to hoist equipment.***

1. Describe the various types, parts, care and maintenance of natural and synthetic rope.
2. Identify and describe the proper procedure for tying popular knots, and hitches.
3. Describe types, parts and care and maintenance of wire ropes.
4. Name differences between chain falls, come-a-longs, tirfors and snatch blocks.
5. Describe characteristics of safe workloads of slings used for hoisting pipe, appliances and components.
6. Describe hand signals when directing a crane.
7. Demonstrate tying of knots and hitches.

H. Relevant Codes ..... 2 Hours

Outcome: ***Apply codes used in the refrigeration and air conditioning (RAC) industry.***

1. Describe the refrigeration codes that apply to RAC work.
2. Describe the gas codes that apply to RAC work.
3. Describe the plumbing codes that apply to RAC work.

4. Describe the electrical codes that apply to RAC work.
5. Describe the sheet metal codes that apply to RAC work.

I. Customer Relations ..... 6 Hours

Outcome: Demonstrate effective customer relations.

1. Describe effective communication techniques.
2. Describe methods used to determine customers' needs.
3. Describe customer reporting methods.
4. Describe job completion strategies.

J. Introduction to Drawing Interpretation ..... 4 Hours

Outcome: Interpret basic drawing information.

1. Use basic information found on drawings.
2. Interpret basic drawings.
3. Identify common symbols used in drawings and legends.
4. Identify abbreviations used in drawings.

K. Pipe Working Skills, Soldering and Brazing ..... 20 Hours

Outcome: Apply pipe working skills on refrigeration, gas and plumbing pipe.

1. Describe tools, equipment and material used for pipe work.
2. Describe tools and equipment used for soldering.
3. Describe tools and equipment used for brazing.
4. Describe oxyfuel equipment components, functions and maintenance.
5. Describe procedures of oxyfuel equipment use.
6. Demonstrate use of tools, equipment and material for pipe work.
7. Demonstrate use of tools and equipment for soldering.
8. Demonstrate use of tools and equipment for brazing.
9. Demonstrate oxyfuel leak detection, adjusting, operating, and shutdown procedures.

L. Materials and Fastening Devices ..... 4 Hours

Outcome: Use materials and fasteners commonly used in the industry.

1. Describe metallic and non-metallic materials' characteristics and applications.
2. Describe types of threaded fasteners and their applications.
3. Describe thread repair methods.
4. Describe types of non-threaded fasteners and their applications.
5. Demonstrate removal of seized and damaged fasteners.

SECTION TWO: INTRODUCTION TO REFRIGERATION, AIR CONDITIONING AND HEATING... 104 HOURS

A. Refrigeration Principles ..... 14 Hours

Outcome: ***Explain the basic operation of a refrigeration system.***

1. Define the terms related to refrigeration principles.
2. Describe the basic concepts of heat transfer.
3. Describe methods of heat transfer.
4. Describe the laws of thermal dynamics.
5. Describe the units of measure pertaining to heat transfer.
6. Describe the function of refrigeration in transportation.
7. Perform calculations related to heat transfer.
8. Convert temperatures and pressures between various scales.

B. Vapour Compression Cycle ..... 10 Hours

Outcome: ***Explain the vapour compression cycle.***

1. Describe the basic concepts of the vapour compression cycle.
2. Describe the four essential components of a refrigeration system.
3. Describe the stages of the refrigeration cycle.
4. Describe the basic operating principles and applications of multiple evaporator systems.
5. Describe the basic difference between single and multiple evaporator systems.
6. Measure the refrigeration cycle on a working system.
7. Demonstrate the operation of a refrigeration system using a diagram.

C. Introduction to Refrigeration Enthalpy and Gas Laws ..... 20 Hours

Outcome: ***Apply gas laws and pressure enthalpy charts to refrigeration systems.***

1. Define terms used in refrigeration and heating.
2. Describe gas laws and how they apply to thermal dynamics.
3. Describe fluids and fluid piping systems as it relates to refrigeration systems.
4. Describe the units of measurement used in refrigeration calculations.
5. Apply formulas used in calculating gas laws and pressure enthalpy.
6. Describe the components of a pressure enthalpy diagram.
7. Plot a basic cycle using a pressure enthalpy diagram.
8. Demonstrate use of formulas for calculating gas laws and pressure enthalpy.

D. Air Properties and Air Flow Designs ..... 10 Hours

Outcome: ***Apply the properties of air as it relates to basic air flow design.***

1. Describe air properties as it relates to heat transfer.
2. Describe methods of heat transfer as they relate to air flow.
3. Describe units of measurement as it relates to air properties.

4. Describe methods used in calculating air flow design.
5. Calculate air flow required for a given heat transfer system.
6. Describe psychometrics.
7. Describe the meaning, function and uses of psychometric charts.
8. Plot and interpret a psychometric chart.

E. Air Handling Systems and Accessories ..... 10 Hours

Outcome: ***Service air handling systems and accessories.***

1. Describe air handling systems.
2. Describe air handling systems components.
3. Describe air handling accessories.
4. Describe air handling equipment maintenance requirements.
5. Define terms and components used in fans, belts and mechanical drives.
6. Demonstrate fan belt installation and mechanical drive alignment.

F. Air Filtration ..... 4 Hours

Outcome: ***Analyze efficiencies of air filtration systems.***

1. Define terms related to filtration.
2. Define filtration components and their application.
3. Describe the operation and efficiency of air filters.
4. Calculate velocities and pressure drops through filters.

G. Refrigeration and Air Conditioning Relevant Codes ..... 4 Hours

Outcome: ***Apply how the B52 Mechanical Refrigeration Code and the Canadian Code of Practice in the Refrigeration and Air Conditioning industry work in Alberta.***

1. Explain the scope and jurisdiction of the different codes.
2. Describe how the B52 relates to the Refrigeration and Air Conditioning industry.
3. Describe how the Canadian Code of Practice relates to the Refrigeration and Air Conditioning industry.
4. Demonstrate how the B52 is used in determining minimum standards in a refrigeration and air conditioning install and maintenance work.
5. Demonstrate how the Canadian Code of Practice is used in determining minimum standards in a refrigeration and air conditioning install and maintenance work.

H. Introduction to Valve Design and Functions ..... 4 Hours

Outcome: ***Maintain or repair valves in RAC systems.***

1. Describe general valve designs.
2. Describe applications of various valves.
3. Describe valve designs for various refrigeration system applications.
4. Describe the purpose, types and procedures for service valves.

5. Describe the purpose, types, construction, location and operation of suction-throttling valves.
6. Demonstrate operation of service valves.

I. Refrigerant and Oil Handling ..... 14 Hours

Outcome: ***Handle refrigerant and refrigeration oil safely.***

1. Describe the evolution and properties of refrigerants and their oils.
2. Describe the safe handling and storage of refrigerants and refrigeration oils.
3. Describe the safe recovery and deposal of refrigerants and refrigeration oils.
4. Describe leak testing methods and instruments used.
5. Describe the evacuation process of refrigeration systems.
6. Describe non OEM refrigerant products available in the industry.
7. Demonstrate the safe recovery and deposal of refrigerants.
8. Demonstrate the safe recovery and deposal of refrigeration oils.
9. Demonstrate leak testing methods and instruments used.
10. Demonstrate the evacuation process of refrigeration systems.
11. Demonstrate the proper maintenance procedures of recovery and evacuation equipment.
12. Demonstrate cleaning procedures for a contaminated system.
13. Complete Heating Refrigeration Air Conditioning Institute (HRAI) refrigerant handling training.

J. Introduction to Gasfitting Fundamentals ..... 5 Hours

Outcome: ***Explain and identify basic gas fundamentals and the purpose, legal status and organization of CAN/CSA Natural Gas and Propane Installation Codes B149.1, B149.2 and the Gas Bulletins.***

1. Describe historical foundations, career opportunities and trade regulatory structure.
2. Describe production, distribution and storage of natural gas.
3. Describe production, distribution and storage of propane gas.
4. State regulations pertaining to the general requirements of the gasfitter trade.
5. Interpret regulations pertaining to the gasfitter trade.

K. Properties of Gas and Principles of Combustion ..... 4 Hours

Outcome: ***Explain basic gas fundamentals.***

1. Identify chemical formulas used by the Refrigeration and Air Conditioning Mechanic trade.
2. Describe the relative densities, liquefaction ratios and heating value of gases.
3. Calculate appliance input values using properties of gases.
4. Identify definitions specific to combustion.
5. Explain the principles of combustion as a chemical change.

6. Describe the products of complete and incomplete combustion.
7. Describe the requirements for combustion air.
8. Describe flame adjustment techniques and correct safety practices when adjusting gas-fired equipment.

L. Introduction to Gasfitting Code and Regulations ..... 5 Hours

Outcome: ***Apply standards pertaining to the installation of piping and tubing systems for various conditions of use in accordance with the CAN/CSA B149.1 Natural Gas and Propane Installation Codes (Sections 1-4) and B149.2 Propane Storage and Handling and the Gas Safety Information Bulletins.***

1. Describe the regulations contained in the scope section of the CAN/CSA B149.1 Natural Gas and Propane Installation Codes, amendments to the code and the regulations pertaining to installers responsibilities.
2. List the regulations contained in the CAN/CSA B149.1 Natural Gas and Propane Installation Codes (Sections 1-4) and B149.2 Propane Storage and Handling and the Gas Safety Information Bulletins pertaining to installation of piping and fittings.
3. List the regulations contained in the CAN/CSA B149.1 Natural Gas and Propane Installation Codes (Sections 1-4) and B149.2 Propane Storage and Handling and the Gas Safety Information Bulletins pertaining to testing of piping and fittings.
4. List the regulations contained in the CAN/CSA B149.1 Natural Gas and Propane Installation Codes (Sections 1-4) and B149.2 Propane Storage and Handling and the Gas Safety Information Bulletins pertaining to purging of piping and fittings.
5. Describe safety practices to be used pertaining to installation of piping and fittings.
6. Describe safety practices to be used pertaining to testing of piping and fittings.
7. Describe safety practices to be used pertaining to purging of piping and fittings.

SECTION THREE: .....INTRODUCTION TO ELECTRICAL THEORY..... 44 HOURS

A. Introduction to Electrical Safety, Connections and Meters ..... 8 Hours

Outcome: ***Use safe work practices on electrically energized equipment.***

1. Describe the hazards related to working with electrical circuits.
2. Describe safety precautions when working with electrical circuits.
3. Describe the physical properties of conductors, semiconductors and insulators.
4. Describe lockout tag out procedures related to working on electrical equipment.
5. Describe types of electrical connections.
6. State the applications of the various meters.
7. List the care and precautions associated with using meters.
8. Identify the connections for meters.
9. Demonstrate electrical connections.
10. Demonstrate range selection and connections of voltmeter, ammeter, ohmmeter and insulation testers.

B. Current, Voltage, and Resistance ..... 6 Hours

Outcome: ***Apply knowledge of voltage, current and resistance and determine how changing the value of any one of them affects the circuit.***

1. Describe an electric current.
2. Describe voltage, current and power.
3. Describe resistance and state and apply Ohm's Law.
4. Connect and verify relationships between voltage, current and resistance according to Ohm's Law.

C. Series Resistive Circuits ..... 4 Hours

Outcome: ***Connect a series resistive circuit and analyze the relationships between current, resistance and voltage.***

1. Define a series circuit.
2. Apply the formula for total resistance in a series circuit.
3. Apply Kirchhoff's voltage law to a series circuit.
4. Determine the voltage drop across a closed-or-open-circuit component in a series circuit.
5. Connect and verify Kirchhoff's current and voltage laws in a series resistive circuit.

D. Parallel Resistive Circuits ..... 4 Hours

Outcome: ***Connect a parallel resistive circuit and analyze the relationships between current, resistance and voltage.***

1. Define a parallel circuit.
2. Apply the formula for a total resistance in a parallel circuit.
3. Apply Kirchhoff's current law to a parallel circuit.
4. Describe the effects of open circuits on a parallel circuit.
5. Connect and verify Kirchhoff's current law in a parallel resistive circuit.

E. Series-Parallel Resistive Circuits ..... 6 Hours

Outcome: ***Connect and analyze a series-parallel resistive circuit.***

1. Identify resistors that are in series.
2. Identify resistors that are in parallel.
3. Calculate the total resistance of a series-parallel circuit.
4. Apply Kirchhoff's current law.
5. Apply Kirchhoff's voltage law.
6. Solve problems involving series-parallel circuits.
7. Connect and verify the relationship of current, voltage and resistance in each part of a series/parallel circuit.

F. Methods of Producing Electro Motive Force (EMF) and Magnetism ..... 8 Hours

Outcome: ***Apply knowledge of EMF when servicing RAC equipment.***

1. Describe the production of EMF by using chemicals.
2. Describe the production of EMF by using heat.
3. Describe the production of EMF by using pressure.
4. Describe the production of EMF by using light.
5. Describe the production of EMF by using magnetism.
6. Describe the production of EMF by using electrostatics.
7. Describe the properties of magnetic materials.
8. Define the terminology related to magnetism.
9. Describe electromagnetism and basic design considerations for electromagnetic devices.
10. Describe how an induced voltage is generated.
11. Describe the process of electromagnetic induction.

G. Fundamentals of Alternating Current ..... 6 Hours

Outcome: ***Apply knowledge of ac circuits when servicing RAC equipment.***

1. Describe the generation of an ac sine wave.
2. Determine the output frequency of an ac generator.
3. Calculate standard ac sine wave values.
4. Demonstrate the relationship between sine waves and phasor diagrams.
5. List the factors affecting impedance in an ac circuit.

H. Arc Flash and Electrical Safety ..... 2 Hours

Outcome: ***Recognize arc flash hazards in electrical installations.***

1. Identify the hazards associated with arc flash.
2. Describe the personal protective equipment related to arc flash.
3. Describe lockout procedures related to energized systems.

SECTION FOUR: ..... INTRODUCTION TO CONTROLS ..... 32 HOURS

A. Introduction to Control Systems ..... 4 Hours

Outcome: ***Service control systems used for heating and cooling.***

1. Describe terminology used in control systems.
2. Describe heating and cocling controls.
3. Describe heating and cooling control systems.
4. Interpret electrical diagrams used to show the function of a heating or cooling control system.

B. Control Components ..... 4 Hours

Outcome: ***Service components used in control systems.***

1. Describe the components of heating and cooling systems.
2. Describe the construction of control system components.
3. Describe the application of control components for heating and cooling system.
4. Describe the operation of control system components.

C. Refrigeration Control Circuits ..... 10 Hours

Outcome: ***Use control circuits for refrigeration systems.***

1. Describe components used in control circuits for refrigeration systems.
2. Describe the differences between medium and low temperature control circuits.
3. Describe the components of a medium temperature control circuit.
4. Describe the components of a low temperature control circuit.
5. Connect and verify operation of a medium temperature cooling control system.
6. Connect and verify operation of a low temperature cooling control system.

D. Heating Ventilating Air Conditioning (HVAC) Control Circuits ..... 8 Hours

Outcome: ***Use control circuits for HVAC systems.***

1. Describe components used in HVAC control circuits.
2. Describe the construction of HVAC control system components.
3. Describe the application of control components for HVAC system.
4. Describe the operation of HVAC control system components.
5. Connect and verify operation of a HVAC control system.

E. Building Systems Controls ..... 6 Hours

Outcome: ***Service building system control circuits.***

2. Describe components used in building control circuits.
3. Describe components and their applications of a pneumatic control system.
4. Describe the construction of building control system components.
5. Describe the application of control components for building system.
6. Describe the operation of building control systems.
7. Describe other systems that affect building control systems.

SECOND PERIOD TECHNICAL TRAINING
TRANSPORT REFRIGERATION TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE: ..... ENGINE FUNDAMENTALS ..... 47 HOURS

A. Engine Basics ..... 9 Hours

Outcome: ***Explain the operating principles and design features of diesel engines.***

1. Describe engine terms and definitions.
2. Describe methods of classifying engines.
3. Describe the principles of operation for four stroke cycle engines.
4. Compare prime mover technologies.

B. Blocks and Liners ..... 4 Hours

Outcome: ***Describe the functions and design of cylinder block assemblies.***

1. Describe the functions, construction and design of engine cylinder blocks and liners.
2. Inspect engine block and liners for problems and wear.
3. Describe cylinder block repair and reconditioning procedures.

C. Pistons and Connecting Rods ..... 4 Hours

Outcome: ***Describe the functions and design of pistons, rings and connecting rods.***

1. Describe the function, construction and design features of piston and connecting rod assemblies.
2. Describe inspection and measurement of piston and connecting rod assemblies.

D. Crankshafts ..... 3 Hours

Outcome: ***Describe the functions and design of crankshafts and related components.***

1. Describe the function, lubrication, design features of crankshafts and related components.
2. Describe methods used to achieve engine balance.
3. Identify common crankshaft and bearing failures.
4. Measure a crankshaft to determine wear and serviceability.

E. Camshafts ..... 4 Hours

Outcome: ***Describe the functions and design of camshafts and related components.***

1. Explain the function and design features of camshaft assemblies.
2. Describe camshaft drive mechanisms and timing
3. Measure a camshaft to determine wear and serviceability.

F. Valve Trains ..... 5 Hours

Outcome: ***Service valve train components.***

1. Describe the design, construction and operation of valve trains and related components.
2. Describe the function and adjustment of the valves.
3. Measure valve train components to determine wear and serviceability.

G. Cylinder Heads ..... 18 Hours

Outcome: ***Service cylinder head components.***

1. Explain the function, construction and design features of cylinder heads.
2. Identify cylinder head sealing and retention devices.
3. Demonstrate cylinder head removal, inspection, installation procedures and precautions.
4. Diagnose cylinder head problems.

SECTION TWO: ..... ENGINE SUPPORT SYSTEMS ..... 22 HOURS

A. Induction Systems ..... 6 Hours

Outcome: ***Service air induction systems and related components.***

1. Describe the functions of air induction system components.
2. Describe the service procedures for air induction systems.
3. Describe the use of test equipment to measure air inlet restriction.

B. Exhaust Systems ..... 6 Hours

Outcome: ***Service exhaust systems and related components.***

1. Describe the function and features of the exhaust system and components.
2. Demonstrate removal and installation procedures for exhaust components.
3. Describe the need for venting the exhaust system gases.

C. Emission Control Systems ..... 7 Hours

Outcome: ***Service emission control systems and related components.***

1. Describe emission control systems, components, function and operation.
2. Diagnose and repair emission control systems.
3. Test engine exhaust temperature.

D. Lubrication and Cooling Systems ..... 3 Hours

Outcome: ***Diagnose lubrication and cooling systems faults.***

1. Describe function and operation of lubrication system components.
2. Demonstrate oil pressure test procedures.
3. Repair lubrication problems.
4. Describe functions and operations of cooling systems.

SECTION THREE: .....FUEL SYSTEMS..... 39 HOURS

A. Fuel Injection Components ..... 30 Hours

Outcome: ***Perform service and repair on fuel injection systems.***

1. Describe the types, design, and operation of transfer pumps.
2. Demonstrate diagnosis, removal and installation procedures for transfer pumps.
3. Describe the demand requirements of an injection system.
4. Describe the design, components, function and maintenance of fuel injection systems.
5. Describe timing advance functions and operations.
6. Demonstrate adjusting and timing procedures.
7. Describe the designs, principle of operation, characteristics, and application of metering systems.
8. Demonstrate removal and installation precautions.
9. Demonstrate inspection and diagnosis procedures for injection systems.
10. Demonstrate replacement and bleeding of injectors.
11. Describe the characteristics and operation of governors.
12. Diagnose problems of governors.

B. Engine Testing and Adjustments ..... 6 Hours

Outcome: ***Perform engine testing and adjustments.***

1. Demonstrate start up, run-up, test and shut down procedures.
2. Diagnose incorrect operating conditions.
3. Demonstrate repairs and adjustments.
4. Describe the effect of altitude change and severe weather conditions.

C. Electronic Fuel Systems..... 3 Hours

Outcome: ***Explain the operating principles and design features of an electronic fuel system.***

1. Describe various types of electronic fuel systems.
2. Identify the components of each type of electronic fuel systems.
3. Describe the operation of an electronic fuel system.

SECTION FOUR: ..... DC FUNDAMENTALS ..... 48 HOURS

A. Starting Systems..... 9 Hours

Outcome: ***Demonstrate a working knowledge of a starting system.***

1. Describe components, designs and operating principles of starter systems.
2. Diagnose starting system problems utilizing a starter load test.
3. Repair starting system problems.

B. Mechanical Generators Systems ..... 9 Hours

Outcome: ***Demonstrate a working knowledge of a dc charging system.***

1. Identify the parts and output of a 12 V dc alternator.
2. Explain the principle of operation and types of alternators.
3. Demonstrate diagnosis of alternator electrical and mechanical faults.
4. Describe common regulator types, function and factors impacting operation.
5. Demonstrate testing and precautions of regulators and circuits.
6. Trace circuits utilizing schematic diagrams and test equipment.
7. Define common charging system terminology.
8. Overhaul an alternator.

C. Battery Fundamentals ..... 3 Hours

Outcome: ***Perform battery maintenance, testing and storage.***

1. List safety precautions and procedures for boosting and charging batteries.
2. Describe multiple battery circuits in relation to connections and battery compatibility.

D. DC Electrical Circuits ..... 12 Hours

Outcome: ***Demonstrate a working knowledge of dc theory.***

1. Explain the relationship between the structure of the atom and the flow of electrons.
2. Define quantity, express symbols and units of measurement.
3. Perform calculations using Ohm's Law.
4. Construct circuits and make voltage, current and resistance measurements.
5. Identify applications of series, parallel and series-parallel circuits.
6. Define Kirchoff's Laws.
7. Measure a circuit to demonstrate Kirchoff's current and voltage laws.
8. Define resistance and what factors impact it.
9. Define insulators.
10. Describe the components, purpose, location, operation and diagnosis of an electronic circuit.
11. Describe the loads controlled by the electronic circuits.
12. Diagnose problems using diagrams and test equipment.
13. Describe the importance of heat dissipation in electrical circuits.
14. Describe magnetic attraction and repulsion.
15. Describe electromagnetism and related terms.
16. Describe the methods used to generate ac and dc.
17. Describe the relationship between cycles, poles and frequency.
18. Identify the basic construction, operation and calculations for transformers.

E. Wiring Diagrams ..... 12 Hours

Outcome: ***Demonstrate a working knowledge of electrical circuits in service work.***

1. Identify the components within transport systems heating and cooling circuits.
2. Demonstrate troubleshooting circuits using schematics, diagrams and testing procedures.
3. Demonstrate test procedures for low and high voltage systems.
4. Demonstrate test procedures for multi-voltage systems.

F. Microprocessors ..... 3 Hours

Outcome: ***Demonstrate a working knowledge of control circuits in service work.***

1. Identify the components and their location within microprocessors.
2. Describe the electrostatic discharge precautions for microprocessors service.
3. Demonstrate the procedures to access the operating screens from the microprocessor.
4. Explain the purpose of software revisions and the upgrade methods.
5. Interpret the alarm codes and clearing procedures.
6. Download data from onboard microprocessor to a computer.
7. Explain the security levels in microprocessors.

SECTION FIVE ..... REFRIGERANT CONCEPTS ..... 49 HOURS

A. Compressors ..... 6 Hours

Outcome: ***Perform compressor diagnosis and repairs.***

1. Describe compressor's components and designs.
2. Describe refrigerant flow through a compressor.
3. Describe the lubrication of compressors.
4. Demonstrate diagnosis and reconditioning procedures.
5. Identify direction of rotation for lubrication.
6. Describe compressor shaft seals replacement.

B. Refrigeration Components ..... 10 Hours

Outcome: ***Describe the purpose of refrigeration components.***

1. Describe the operation of a refrigeration system using a diagram.
2. Identify the components and their functions.
3. Describe the purpose, types, construction and air flow of an evaporator.
4. Explain how distributors avoid excessive pressure drops in a system.
5. Describe the purpose, types and procedures for service valves.
6. Identify the purpose, types, construction, location and operation of suction-throttling valves.
7. Explain the purpose of the pressure safety release valves.
8. Recognize the types of pressure release devices.
9. Describe the operating principles and applications of multiple evaporator systems.

10. Explain the difference between single and multiple evaporator systems.
11. Describe the operating principles and applications of multiple compressor systems.

C. System Specific Diagnostics ..... 15 Hours

Outcome: Diagnose and repair mobile refrigeration systems.

1. Demonstrate master check procedures to evaluate unit condition.
2. Interpret manifold gauge readings for diagnostic purposes.
3. Test system operations to ensure superheating and sub-cooling conditions.
4. Describe the characteristics of a starving evaporator.
5. Describe the characteristics of a flooded evaporator.
6. Test 3-way valve operation and service.
7. Test flow control devices and service.
8. Replace faulty valves in a refrigeration system.
9. Diagnose a distributor tube.
10. Describe the heating method for accumulators.
11. Adjust suction pressure to specifications.
12. Verify optimal performance of system.
13. Identify components that can be replaced after a pump down versus an evacuation.

D. Soldering and Brazing ..... 12 Hours

Outcome: Perform soldering and brazing operations.

1. Describe the characteristics, composition, and safe handling of welding gases and cylinders.
2. Identify the oxyfuel equipment parts, function and maintenance.
3. Demonstrate oxyfuel leak detection, adjusting, operating, and shutdown procedures.
4. Describe the problems and corrective procedures of oxyfuel equipment use.
5. Describe solder and brazing materials.
6. Describe repairs that can be achieved with brazing and soldering.
7. Demonstrate soldering and brazing.
8. Demonstrate tubing flaring, repairs, bending, swedging and pinching.
9. Describe the purpose and procedure for annealing copper tubing.

E. Factors Affecting System Performance ..... 6 Hours

Outcome: Describe physical factors that impact refrigeration.

1. Describe the purpose of insulation and seals within the industry.
2. Identify product temperature for loading, heat removal and temperature stabilization.
3. Describe the principles, methods, conditions and precautions for food and other cargo during loading, preservation and air circulation.
4. Calculate heat removal for the pre-cooling, heat removal, temperature stabilization and wall heat gain.
5. Fill out manufacturer's forms for load estimating.

6. Calculate product and total loads considering cargo safety.

SECTION SIX: SECONDARY SYSTEMS ..... 31 HOURS

A. Liquid Propane Gas (LPG) Heating Systems ..... 4 Hours

Outcome: ***Perform service and maintenance on liquid propane gas heating systems.***

1. Describe construction and operating principles of catalytic heaters.
2. Describe safety precautions when lighting, servicing and installing heating systems.
3. Demonstrate handling, storage, testing procedures and precautions.
4. Describe insulators, isolators, and expansion devices.
5. Describe types and operation of mobile storage tanks.
6. Describe storage tank mounting and security precautions.
7. Describe the capacity and filling of L.P.G. tanks.
8. Demonstrate servicing, testing and adjustments of heating systems.

B. Liquid Fuel Fired Heating Systems ..... 23 Hours

Outcome: ***Perform service and maintenance on liquid fired heating systems.***

1. Describe construction and operating principles of fuel fired heaters.
2. Describe safety precautions for servicing and installing fuel fired heater systems.
3. Demonstrate testing procedures and precautions.
4. Demonstrate the servicing, testing and adjustment of fuel fired heater systems.

C. Auxiliary Power Systems ..... 4 Hours

Outcome: ***Demonstrate service and repair of auxiliary power systems.***

1. Describe purpose, construction and operating principles of auxiliary power units.
2. Describe the conditions and regulations that require auxiliary power units.
3. Describe the diagnosis and service of auxiliary power units.

SECTION SEVEN: COACHING, ALBERTA'S INDUSTRY NETWORK ..... 4 HOURS

A. Workplace Coaching Skills ..... 2 Hours

Outcome: ***Use coaching skills when training an apprentice.***

1. Describe the process for coaching an apprentice.

B. Alberta's Industry Network ..... 2 Hours

Outcome: ***Describe the role of the Alberta Apprenticeship and Industry Training Board and the network of industry committees that represent the trades and occupations in Alberta.***

1. Describe Alberta's apprenticeship and industry training system.
2. Describe the roles and responsibilities of the Alberta Apprenticeship and Industry Training Board, government and post-secondary institutions.
3. Describe the roles and responsibilities of the PACs, LACs and occupational committees.

THIRD PERIOD TECHNICAL TRAINING
TRANSPORT REFRIGERATION TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS COURSE THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE: ..... BASIC REFRIGERATION AND AIR CONDITIONING.....128 HOURS

A. Evaporator Feed Controls and Refrigeration Effect .....16 Hours

Outcome: Service evaporator feed controls on refrigeration equipment.

1. Define terms related to evaporator feed control and refrigeration effect.
2. Describe types and operations of evaporator feed controls.
3. Describe components of evaporator feed control systems.
4. Describe control characteristics of expansion control devices.
5. Describe methods of producing the refrigeration effect.
6. Determine the proper metering device for various applications.
7. Demonstrate troubleshooting techniques of metering devices.
8. Measure superheat and adjust a thermal expansion valve (TXV).

B. Automatic Flow Controls and Applications .....10 Hours

Outcome: Use automatic flow controls in a refrigeration system.

1. Define terms related automatic flow controls.
2. Describe components of automatic flow controls.
3. Describe the operation of automatic flow controls.
4. Describe the application of automatic flow controls.
5. Demonstrate service of automatic flow controls.

C. Refrigeration Accessories .....4 Hours

Outcome: Maintain and repair refrigeration accessories.

1. Define terms related to refrigeration accessories.
2. Describe components related to refrigeration accessories.
3. Describe the operation of various refrigeration accessories.
4. Describe the application of various refrigeration accessories.

D. Compressors .....14 Hours

Outcome: Perform compressor diagnosis and repairs.

1. Define terms related to compressors and refrigeration circuit components.
2. Describe types of compressors used in refrigeration and air conditioning systems.
3. Describe the components and operating characteristics of compressors.
4. Define terms related to compressor mechanical components.
5. Describe compressor components and their applications.

6. Describe the compression process and the flow of gas through the compressor.
7. Describe types of compressor lubrication.
8. Describe mechanical and electrical oil failure controls.
9. Describe capacity control systems.
10. Label a compressor circuit.
11. Disassemble and reassemble a small semi hermetic compressor.
12. Identify direction of rotation for lubrication.
13. Install, wire and check the operation of an oil failure control.

E. Evaporators and Condensers ..... 6 Hours

Outcome: ***Explain the operation and components of evaporators and condensers.***

1. Define terms related to evaporators and condensers.
2. Describe evaporator components and their applications.
3. Describe evaporator defrost methods.
4. Describe condenser components and their applications.
5. Describe service and repair of evaporators and condensers.
6. Describe how distributors avoid excessive pressure drops in a system.
7. Demonstrate evaporator and condenser sizing and balancing methods.

F. Evaporative Condensers and Cooling Towers ..... 6 Hours

Outcome: ***Explain the operation and components of evaporative condensers and cooling towers.***

1. Define terms related to evaporative condensers and cooling towers.
2. Describe evaporative condenser components and their applications.
3. Describe cooling tower components and their applications.
4. Describe water treatment procedures as it relates to cooling towers.
5. Describe seasonal operation of cooling towers.

G. System Install and Commissioning ..... 36 Hours

Outcome: ***Performs system install and commissioning of refrigeration and air conditioning (RAC) systems.***

1. Describe methods of selecting and locating system components.
2. Describe methods of mounting condensing units and evaporators.
3. Describe methods of connecting piping and accessories to an RAC system.
4. Compare the use of various piping materials.
5. Sketch an electrical wiring schematic for an RAC system.
6. Sketch a piping schematic for an RAC system.
7. Install and connect an RAC system.

8. Start-up an RAC system.
9. Complete a commissioning report for an RAC system.

H. System Calculation and Analysis ..... 24 Hours

Outcome: ***Troubleshoot, calculate and analyze refrigeration and air conditioning (RAC) systems.***

1. Define thermal dynamics as it pertains to service and troubleshooting of RAC systems.
2. Describe pressure enthalpy diagrams as they relate to various RAC system conditions.
3. Describe formulas used in analyzing system thermal dynamics.
4. Analyze and troubleshoot RAC systems using pressure enthalpy diagrams and system thermal dynamic formulas.
5. Use tools and charts to troubleshoot RAC systems under various conditions.

I. Retrofitting and Conversions ..... 8 Hours

Outcome: ***Perform retrofitting and conversions on RAC equipment.***

1. Describe steps used in designing and retrofitting or converting RAC systems.
2. Describe the hazards related to retrofitting or converting RAC systems.
3. Describe start-up and monitoring steps of a retrofitted or converted RAC system.

J. Split Systems ..... 4 Hours

Outcome: Service split cooling systems.

1. Identify the components used in a typical cooling system.
2. Describe the operation of a typical cooling system.
3. Identify the requirements for combining a basic cooling system with an existing forced-air heating system.
4. Observe the operation of a combined heating and cooling system.

SECTION TWO: ..... BASIC HEATING ..... 32 HOURS

A. Natural Draft Burner Adjustments and Gas Consumption ..... 6 Hours

Outcome: ***Install and adjust pressure controls and gas-fired burners using ratings plates, gas meters, manometers and mechanical gauges to optimize consumption for gas-fired appliances.***

1. Determine appliance settings using rating plates, altitude designation and listed approval agencies.
2. Describe the requirements from the CAN/CSA B149.1 Natural Gas and Propane Installation Codes, CAN/CSA B149.2 Propane Storage and Handling Code and the Plumbing and Gas Safety Service Bulletin pertaining to gas appliance and adjustments and installer's responsibilities.
3. Define parts of a burner and burner terminology.
4. Measure manifold pressures to determine gas consumption of burners in both imperial and metric units.
5. Adjust orifices and manifold pressures to optimize gas consumption.
6. Identify meter dials and meter indexes in both metric and imperial units.

7. Explain principles of low pressure gas meter clocking.
8. Calculate gas consumption using timed meter readings.

B. Pilots, Pilot Burners, Thermocouples and Thermopiles ..... 6 Hours

Outcome: ***Service pilots, pilot burners, thermocouples and thermopiles.***

1. Describe pilot burner types and terminology.
2. Describe characteristics of pilot burners
3. Identify parts of aerated and non-aerated pilot burners.
4. State the primary purpose of a gas pilot
5. Describe burner ignition tests performed on all pilots.
6. Describe operating principles of thermocouples and thermopiles.
7. Describe the operation tests performed on proven pilots energizing a thermocouple.
8. Describe methods of installing thermocouples and thermopiles on standard circuits.
9. Describe operational tests performed on thermocouples and thermopiles.
8. Describe diagnostic tests for thermocouples
9. State causes for thermocouple failures.

C. Pressure Regulators and Orifices ..... 8 Hours

Outcome: ***Service gas pressure controls and burner orifices and adjust gas line pressure.***

1. Describe types, operating principles and applications or various gas pressure regulators.
2. Identify regulator sizing tables and list and describe correct installation procedures for various regulators.
3. Describe maintenance procedures for various regulators.
4. Describe pressure regulator problems and corrective procedures.
5. Identify types of orifices.
6. Use orifice sizing charts to determine orifice sizing for specific gas consumptions and pressure in both metric and imperial units.
7. Drill an orifice according to specific gas requirements
8. Demonstrate procedures for testing an orifice and adjust manifold pressure on HVAC equipment.

D. Introduction to Flues, Draft Hoods and Vent Connections ..... 6 Hours

Outcome: ***Service draft hoods and vent connectors.***

1. Define terminology pertaining to flues and draft control devices.
2. Describe flue collars and types of draft hoods including installation procedures.
3. Explain regulations pertaining to the sizing, installation and use of draft hoods on gas burning appliances as listed in the CAN/CSA B149.1 *Natural Gas and Propane Installation Code and STANDATA.*
4. Describe installation procedures for single and double acting barometric dampers.
5. Explain regulations pertaining to the selection, sizing, installation and use of draft control devices as specified in the CAN/CSA B149.1 *Natural Gas and Propane Installation Code and STANDATA.*
6. Describe vent connectors and installation techniques.

7. Explain regulations pertaining to vent connectors as listed in the CAN/CSA B149.1 *Natural Gas and Propane Installation Code and STANDATA.*
8. Size vent connectors using minimum size rules.

E. Single Line Drawings ..... 4 Hours

Outcome: ***Draw and interpret basic orthographic and isometric drawings.***

1. Draw and label the three views of orthographic drawings.
2. Draw sections of a simple object.
3. Draw and label orthographic single-line piping drawings with 90° elbows and tees and convert to isometric drawings.
4. Draw and label isometric single-line piping drawings containing 90° elbows and tees.

F. Heating with Alternative Methods ..... 2 Hours

Outcome: ***Service alternative heating systems.***

1. Describe alternative heat sources.
2. Describe alternative heat source systems.

SECTION THREE: ..... BASIC CONTROLS ..... 32 HOURS

A. Principles of Automatic Heating and Cooling Controls ..... 6 Hours

Outcome: ***Explain the basic principles for automatic controls for heating and cooling systems.***

1. Describe the basic requirements of heating and cooling systems.
2. Describe the control components of a basic forced-air heating system.
3. Interpret basic electrical diagrams used to show the function of a heating or cooling control system.
4. Identify code requirements relating to the electrical installation of heating and cooling systems.

B. Temperature Sensing and Control Devices ..... 4 Hours

Outcome: ***Service temperature sensing and control devices.***

1. Identify operating characteristics of temperature-sensing devices.
2. Describe the application of temperature-sensing devices used in heating and cooling systems.
3. Describe the functions of thermostats in heating and cooling systems.

C. Basic Gas-Fired Forced-Air Heating Systems ..... 6 Hours

Outcome: ***Connect and troubleshoot basic 24 V and 120 V gas-fired, forced-air heating systems.***

1. Identify the components used in a basic gas-fired, forced-air heating system.
2. Describe the operation of a domestic heating system using a 24 V control circuit.
3. Describe the operation of a unit heater using a 120 V control circuit.
4. Describe the installation and operation of a fan interlock system on a residential forced air heating system.

5. Connect and verify a 24 V and 120 V control heating system.
6. Diagnose and repair 24 V and 120 V heating systems.

D. Mid/High-Efficiency / Gas-Fired / Forced-Air Heating Systems ..... 6 Hours

Outcome: ***Connect and troubleshoot mid and high-efficiency, gas-fired, forced-air heating systems.***

1. Identify the components of a mid-efficiency, gas-fired, forced-air heating system.
2. Troubleshoot a mid-efficiency, gas-fired, forced-air heating system.
3. Troubleshoot a high-efficiency, gas-fired, forced-air heating system.
4. Describe the purpose of and application of auxiliary equipment used with gas-fired, forced-air heating systems.
5. Connect and verify the operation of a direct spark ignition system in a high-efficiency gas-fired furnace.
6. Connect and verify the operation of a hot surface ignition system in a high-efficiency gas-fired furnace.

E. Basic Hot Water Heating Systems ..... 2 Hours

Outcome: ***Troubleshoot basic hot water heating systems.***

1. Describe the operation of a basic hot water heating system.
2. Identify the purpose and application of the components of a hot water heating system.
3. Analyze and troubleshoot the operation of a hot water heating system.

F. HVAC Units ..... 8 Hours

Outcome: ***Troubleshoot a basic commercial heating and cooling control circuit for an HVAC unit.***

1. Describe the components of an HVAC unit.
2. Describe the operation of an HVAC unit.
3. Describe the applications of thermostats.
4. Describe procedures for troubleshooting a HVAC unit.
5. Troubleshoot the operation of a HVAC unit.

SECTION FOUR: ..... BASIC ELECTRICAL THEORY ..... 48 HOURS

A. Single-Phase Transformers ..... 4 Hours

Outcome: ***Connect single-phase transformers on refrigeration RAC equipment.***

1. Describe the construction of a mutual induction transformer.
2. Describe the construction of a single winding transformer.
3. Determine the transformation ratio and volts-per-turn value of a transformer.
4. Describe transformer operation.
5. Describe the operation of current limiting (Class 2) transformers.
6. Describe the efficiencies of a transformer

7. Calculate the efficiency of a transformer.
8. Describe the connection options for a multiple winding transformer.
9. Identify, connect and perform tests on transformers.

B. Single Phase Motors ..... 14 Hours

Outcome: Connect and service split-phase, single phase motors.

1. Describe the components, principles of operation and applications of a resistance split-phase motor.
2. Describe the components, principles of operation and applications of a capacitor-start motor.
3. Draw connection diagrams for single phase motors.
4. Describe the components, principle of operation and applications of a permanent-split-capacitor motor.
5. Describe the components, principle of operation and applications of a capacitor start/capacitor run motor.
6. Connect and analyze a dual voltage motor and reverse it.
7. Connect and analyze a multispeed single phase motor.

C. Compressors and Electrical Circuit Components ..... 10 Hours

Outcome: Connect and service compressors and circuit components.

1. Describe motor starters and relays of compressors.
2. Describe motor protection used for compressors.
3. Sketch a motor starter circuit.
4. Sketch a compressor overload circuit.
5. Connect a single phase compressor circuit.
6. Troubleshoot motor failures and clean up procedures.

D. Three Phase Fundamentals ..... 6 Hours

Outcome: Service three phase electrical systems on RAC equipment

1. Describe the difference between single phase power and three phase power.
2. Describe the generation of the phase voltages of a three phase system.
3. Describe the phase sequence of three phase sine waves.
4. Describe the advantages and disadvantages of three phase power over single phase power.

E. Troubleshooting Electrical Problems ..... 10 Hours

Outcome: Solve electrical related problems in refrigeration and HVAC circuits.

1. Describe electrical problems common to refrigeration and HVAC circuits.
2. Describe methods used to test circuits in refrigeration and HVAC circuits.
3. Describe the possible effects of over voltage and under voltage on motors.
4. Describe the importance of full load amps, lock rotor amps and free running amps.
5. Use wiring diagrams to troubleshoot refrigeration and HVAC circuits.
6. Diagnose electrical motor problems using systematic test flowcharts.

7. Troubleshoot motors that are operating at higher than normal temperatures.
8. Perform tests on other electrical devices related to motor circuits.

F. Introduction to Canadian Electrical Code ..... 2 Hours

Outcome: ***Apply the Canadian Electrical Code (CEC) Part I, and the Alberta Electrical STANDATA to verify electrical installations in Alberta.***

1. Describe the purpose of the CEC Part 1.
2. Describe the procedures for the acceptance of the CEC by the provinces and the local authorities.
3. Describe the function of the electrical STANDATA.
4. Describe the organizational layout of the CEC.
5. Identify those responsible for an electrical installation.

G. Class 1 and Class 2 Circuits ..... 2 Hours

Outcome: ***Verify CEC requirements for Class 1 and Class 2 Circuits on RAC equipment.***

1. Define the terms from the CEC on Class 1 and Class 2 circuits.
2. Identify the requirements for Class 1 and Class 2 circuits.
3. Identify the Class 2 circuits as they apply to industry.

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